

REMARKS

Claims 1-13, 21 and 24-26 are pending in the application. Claims 4 and 6 are withdrawn from consideration as drawn to non-elected species. Claims 24-26 have been added.

Specification

The references to the various US patent applications cited in the specification have been checked for updating. Application No. 10/772,228 has issued since the filing of the last response and its corresponding patent number has been provided.

Claim rejections under 35 U.S.C. §103

The withdrawal of the prior art rejections over Visco is gratefully acknowledged. All claims remain rejected according to a series of new rejections: Claims 1, 3, 9 and 21 were rejected under 35 U.S.C. §103(a) as being unpatentable over JP 55-081471 A (JP '471) in view of either commonly assigned U.S. Patent 6,413,285 to Chu (Chu) or JP 62-243247 (JP '247). Claims 2, 7 and 10-12 were rejected under 35 U.S.C. §103(a) as being unpatentable over JP '471 in view of) in view of Chu or JP '247 as applied to claim 1, and further in view of US 5,314,765 to Bates (Bates '765). Claim 5 was rejected under 35 U.S.C. §103(a) as being unpatentable over JP '471 in view of Chu or JP '247 as applied to claim 1, and further in view of US 3,976,509 to Tsai (Tsai). Claim 8 was rejected under 35 U.S.C. §103(a) as being unpatentable over JP '471 in view of Chu or JP '247 as applied to claim 1, and further in view of US 6,025,094 to Visco et al. (Visco '094). Claim 13 was rejected under 35 U.S.C. §103(a) as being unpatentable over JP '471 in view of Chu or JP '247 and Bates as applied to claim 12, and further in view of US 6,485,622 to Fu (Fu).

Independent claim 1, as currently amended, recites:

An electrochemical cell, comprising:

a renewable active metal anode, configured for supplementation of the active metal, the anode comprising a first solid state lithium metal layer and a second solid state lithium metal layer and having a thin layer of Ag, Al, Sn or other Li alloy-forming metal interposed between the first and second lithium layers;

a cathode structure comprising an electronically conductive component, an ionically conductive component, and a fluid oxidant;

an ionically conductive protective membrane on the first surface of the anode, the membrane comprising,

one or more materials configured to provide a first surface chemically compatible with the active metal of the anode in contact with the anode, and a second surface substantially impervious to and chemically compatible with the cathode structure and in contact with the cathode structure.

The other pending claims depend directly or indirectly from independent claim 1 and thus incorporate this recitation. The recitation that the active metal anode is a renewable active metal anode that is configured for supplementation of the active metal has been reintroduced into the claim from a prior amendment. As noted in that prior response, the cell has, in addition to the renewable active metal (e.g., lithium) anode, a cathode structure that includes an electronically conductive component (e.g., a porous metal or alloy), an ionically conductive component (e.g., an electrolyte), and a fluid oxidant (e.g., air, water or a peroxide or other aqueous solution). The pairing of an active metal anode with a cathode oxidant in the cell is enabled by an ionically conductive protective membrane on the surface of the anode facing the cathode. The active metal anode is renewable in that it is configured for supplementation of the active metal to provide a fuel supply for continuous operation of the cell for as long as desired.

In the solid state implementation of the invention, the supplementation of the active metal can be accomplished by contacting the existing active metal of the anode with additional active metal having a bond coat such as a thin layer of Ag, Al, Sn or other suitable active alloy-forming metal in an inert environment. Claim 1 has also been previously amended to recite this supplementation implementation for a lithium-based anode. The new Li/bonding layer alloys to the old anode metal thereby supplementing it as or once it is depleted in the fuel cell redox reaction with the cathode oxidant. Obviously, in order for supplementation to occur in this recited manner, access to the bulk lithium of the anode must be available. The anode is configured for this supplementation by providing this access.

Since there are consumable reactants on both the anode and cathode sides of the ionically conductive protective membrane, the cell is referred to in the disclosure as a fuel cell. The anode “fuel” may be in the solid or liquid phase. The cathode structure includes an electronically conductive component (e.g., a porous metal or alloy), an ionically conductive component (e.g., an electrolyte), and a fluid oxidant (e.g., air, water or a peroxide or other aqueous solution). Advantageously, the cathode structure may include fluid oxidants that are obtained from the cell’s operating environment, such as air or fresh or salt water.

JP ‘471, to the extent that the disclosure can be understood from the English language abstract, clearly relates to a battery cell, and thus is understood not to teach or suggest the renewable active metal anode configured for supplementation of the active metal of the claimed invention.

With particular relevance to the claimed invention, JP '471 illustrates and seems to describe a battery cell that is closed and sealed on the anode side. Such a configuration does not provide access for supplementation of the anode as described and presently claimed, and is respectfully submitted to not be renewable and configured for supplementation of the active metal of the anode as described and presently claimed in claim 1. Accordingly, it is respectfully submitted that JP '471 fails to teach this aspect of the claimed invention.

The cited Chu and JP '247 references do not cure the noted deficiencies of JP '471 with regard to the present invention. Chu relates to battery cell fabrication and, while it describes a technique for using a bonding layer in battery cell electrode fabrication (i.e., prior to operation of the cell), there is no teaching or suggestion therein of supplementing the anode of an electrochemical cell once or as its solid state lithium anode is depleted, as described and claimed herein. The same is true of the JP '247 disclosure, to the extent it can be understood from the abstract. Moreover, the battery cell described in JP '247 is explicitly a wound cell. Such a cell geometry does not lend itself to supplementation of the anode as described and claimed herein since, at best, only limited access to the anode material can be obtained after fabrication. It is respectfully submitted that such a call cannot be said to be renewable and configured for supplementation of the active metal of the anode as described and presently claimed in claim 1.

Accordingly, it is respectfully submitted that claim 1 is patentable over the cited art. The remaining claims are dependent on claim 1 and thus incorporate all of its limitations, and are therefore submitted to be allowable for at least the same reasons, since the remaining secondary references do does cure the noted deficiencies of the combination of JP '471 with Chu and/or JP '247. Withdrawal of the rejections under 35 U.S.C. 103(a) is thus respectfully requested.

Double Patenting

Claims 1-3, 5, 7-13 and 21 are provisionally rejected on the ground of obviousness-type double patenting over claims of commonly assigned co-pending application 10/772,157 of Visco et al. (Visco '157) in view of Chu or JP '247. This rejection is respectfully traversed.

As noted above, the presently pending claims recite, in relevant part, "a renewable active metal anode, configured for supplementation of the active metal..." [emphasis added]. The noted claims of Visco '157 recite battery and other electrochemical cells having active metal anodes. However, the claims lack any teaching or suggestion of the recited renewable active metal anode, configured for supplementation of the active metal. For the reasons noted above, it is respectfully submitted that Chu and JP '247 do not supply the missing teachings of Visco '157 with regard to the present claims. Accordingly, it is respectfully submitted that the presently pending claims are not

rendered obvious by the claims of Visco '157 in view of Chu or JP '247, and withdrawal of the obviousness-type double patenting rejection on this basis is respectfully requested.

While not presently believed to be the case, should it be ultimately necessary, Applicants propose to file Terminal Disclaimers in one or both of these applications, as appropriate, in order to obviate any remaining obviousness-type double patenting issues prior to the conclusion of prosecution.

New Claims

Claims 24-26 have been added to recite specific first components for a composite anode protective membrane in accordance with various specific embodiments of the present invention. These *in situ* formed composite reaction products of Li with Cu₃N, P and PbI₂, described at page 12, line 21 to page 13, line 6 of the application, are respectfully submitted to provide an additional basis for patentability, beyond that presented above, for these new claims.

Conclusion

Applicants believe that all pending claims are allowable and respectfully request a Notice of Allowance for this application from the Examiner. Should the Examiner believe that a telephone conference would expedite the prosecution of this application, the undersigned can be reached at the telephone number set out below. If any additional fees are due in connection with the filing of this amendment, the Commissioner is authorized to charge such fees to Deposit Account 504480 (Order No. PLUSP038).

Respectfully submitted,
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